INVITATION FOR BIDS
OFFICE OF PROCUREMENT SERVICES

1. INSTRUCTIONS FOR BIDDERS

a. Sealed bids will be received in the Office of Procurement Services, Mississippi State University, for the purchase of the items listed herein.

b. All bids must be received in the Office of Procurement Services on or before the bid opening time and date listed herein. Delivery of bids must be during normal working hours, 8:00 a.m. to 5:00 p.m. CST, except on weekends and holidays when no delivery is possible.

c. Bidders shall submit their bids either electronically, in Bully Buy, or in a sealed envelope. Bids CANNOT be emailed
   a. Sealed bids should include the bid number on the face of the envelope as well as the bidders' name and address. Bids should be mailed to : 245 Barr Avenue, 610 McArthur Hall, Mississippi State, MS 39762.

d. All questions regarding this bid should be directed to the Office of Procurement Services at 662-325-2550.

2. TERMS AND CONDITIONS

a. All bids should be bid "FOB Destination"

b. Bidders must comply with all rules, regulations, and statutes relating to purchasing in the State of Mississippi, in addition to the requirements on this form. General Bid Terms and Conditions can be found here: https://www.procurement.msstate.edu/procurement/bids/Bid_General_Terms_May_2019_V2.pdf

c. Any contract resulting from this Invitation for Bid shall be in substantial compliance with Mississippi State University's Standard Contract Addendum: https://www.contracts.msstate.edu/resources/standard-forms

Bid Number: MSU2026111
Opening Date: Tuesday October 13, 2026 at 2:00 p.m.
Description: Recirculating Trailwater Reduces Nutrient Loss in Agriculture

Vendor Name: ____

Vendor Address: ____

Telephone Number: ____

Email Address: ____

Days the Offer is Firm: ____

Authorized Signature: ____

Name: ____

Title: ____

Item	Quantity	Description	Unit Price	Total Price
1	1	Recirculating Tailwater Reduces Nutrient Loss in Agriculture		

Project Title: Recirculating Tailwater Reduces Nutrient Loss in Agriculture

Project Duration: 42 Months (1 January 2027 to 30 June 2030)

Project Background:

This project aims to employ innovative, in-field water recirculating technologies that economically reduce nutrient and sediment runoff from agricultural production lands. The central hypothesis for this project is that autonomous, tailwater-recirculating technology can be integrated into end-blocked, furrow-irrigated fields to increase irrigation efficiency and N utilization while also reducing nutrient runoff and improving the crop's productivity and profitability relative to furrow-irrigated production systems that do not reuse tailwater. This goal will be accomplished by completing three objectives: 1) Develop novel tailwater recirculating techniques that improve runoff water quality from rice production, 2) Improve rice productivity and profitability, and 3) Increase knowledge and promote implementation of strategies that reduce nutrient loss in rice.

The effectiveness of capturing and reusing tailwater to reduce nutrient runoff will be evaluated by conducting replicated demonstrations that compare the proposed strategy with conventional rice water management practices. We will conduct demonstrations from 2027 to 2029 at a minimum of 3 on-farm locations per year in the Gulf of America Watershed, with at least 12 locations over the project period. Each location will consist of paired production-scale fields with the same soil texture, crop rotation, cultivar, and planting date. Within a location, each production-scale field will be randomly assigned as either conventional water management or tailwater recirculating. The two production systems will include:

1. Furrow irrigation without tailwater reuse (conventional water management): Following non-rice crop production, raised beds will remain intact or be re-formed to ensure the downslope movement of water during irrigation and rainfall events. Rice will be drill-seeded, and furrow irrigation applied via holes punctured in lay-flat polyethylene tubing laid perpendicular to row orientation at the field crown. Computerized hole selection will be implemented to improve irrigation uniformity across the field (Bryant et al., 2017). Fields will be end-blocked and a perforated PVC tube with attached ultrasonic water level sensor will be installed in the upper 1/4 of each field to monitor water level (Figure 1). Irrigation will be applied when the water level in the upper 1/4 of the field subsides to 10 cm below the soil surface.

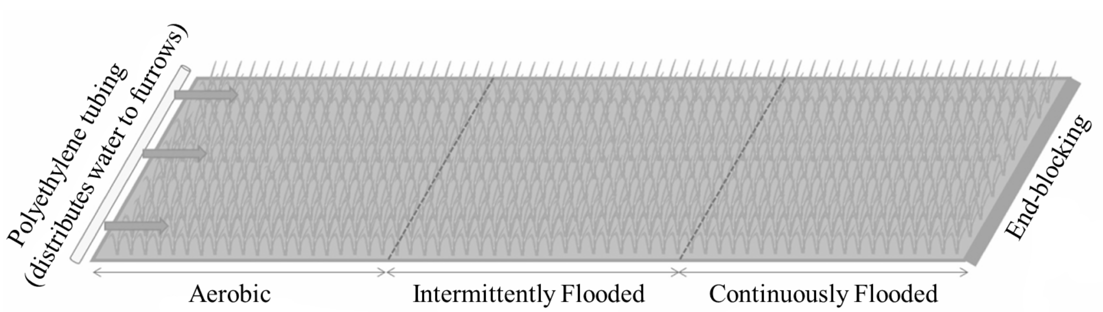

Figure 1. End-blocking creates three distinct soil moisture zones in furrow-irrigated rice fields that include an aerobic zone near the field crown, an intermittently flooded zone in the middle, and a constantly flooded zone at the downslope end of the field. (Adapted from Massey et al., 2022).

2. Furrow irrigation with tailwater reuse: Following non-rice crop production, raised beds will remain intact or be re-formed to ensure the downslope movement of water during irrigation and rainfall events. Rice will be drill-seeded, and furrow irrigation applied via holes punctured in lay-flat polyethylene tubing laid perpendicular to row orientation at the field crown. Computerized hole selection will be implemented to improve irrigation uniformity across the field (Bryant et al., 2017). Fields will be end-blocked and a perforated PVC tube with attached ultrasonic water level sensor will be installed in the upper 1/4 of each field to monitor water level. To increase nitrogen uptake, saturated conditions will be maintained across the entire field for 21 days after nitrogen fertilizer application by continuously applying tailwater with the pit-less, recirculating pump (Figure 2; Atwill et al., 2018). Moreover, saturated conditions will be maintained during flowering as rice is sensitive to drought stress at this critical growth stage (Atwill et al., 2018). Outside of these two critical windows, water levels will oscillate from 10 cm below the soil surface to the soil surface via our automated, pit-less tailwater recirculating system.

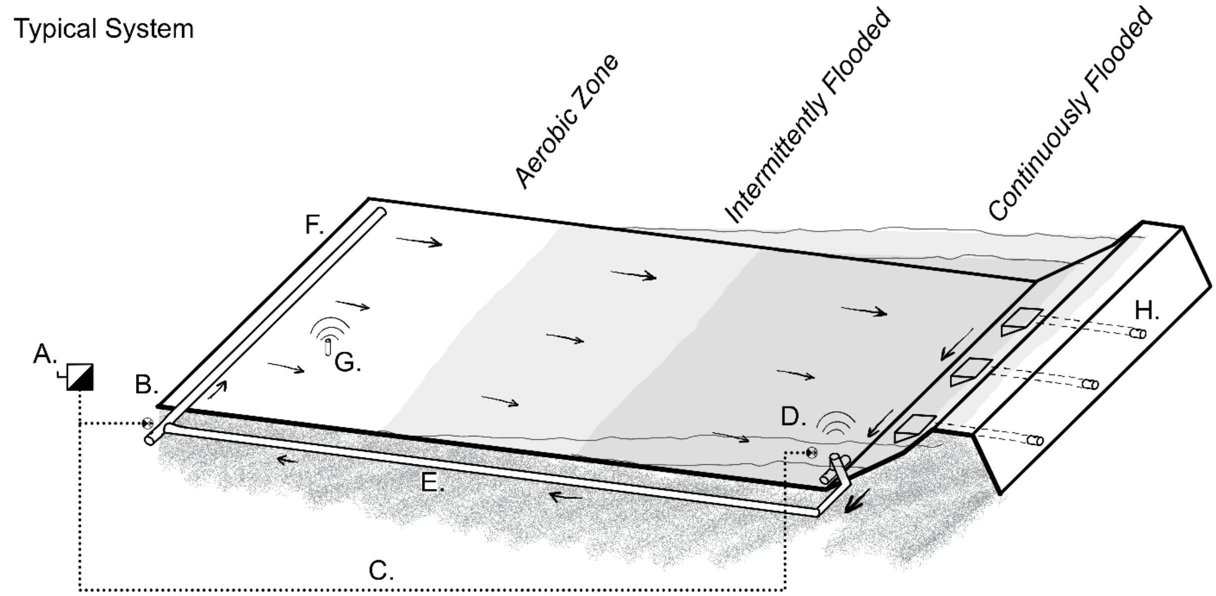

Figure 2. Schematic of a prototypical design for an autonomously irrigated, furrow-irrigated rice field whereby tailwater in the continuously flooded zone is lifted via a recirculating pump and delivered to the aerobic zone via lay-flat tubing: A) groundwater well pump with pump controller and telemetry; B) field riser and three-way actuated valve assembly that connects ground water and surface water supplies; C) buried electric supply cable supplies power to the recirculating pump; D) relift pump with pump controller and telemetry; E) 38-cm woven, lay-flat transfer pipe; F) 30-cm lay-flat, polyethylene tubing that delivers surface or groundwater to the upslope end of the furrow-irrigated field; G) soil water sensor that initiates irrigation at predetermined thresholds via communicating wirelessly with the ground water and tailwater pumps.

There are three primary objectives that will be accomplished. The major tasks associated with each objective are included below.

Objective 1: *Develop novel tailwater recirculating techniques that improve runoff water quality in rice production.*

The effects of capturing and reusing tailwater via an autonomous recirculating system on runoff water quality will be monitored at both paired fields at three demonstration locations per year. Every field will be outfitted with a rain gauge and flowmeter to quantify water input as precipitation and supplemental irrigation applied, respectively. Runoff water quantity and quality will be monitored by equipping outflow pipes with an automatic runoff sampler (ISCO GLS, Teledyne ISCO, Lincoln, Nebraska) and flow rate sensor, such as an area velocity flow sensor (ISCO 2150), to collect water samples and flows for runoff events as conducted in our previous research (Badon et al., 2021; Bryant et al., 2020d; Zablotowicz et al., 2006). Within 24 hours of rainfall or irrigation events, runoff samples will be collected, placed on ice, immediately transported to an EPA-certified laboratory for analysis. Variables measured will include runoff volume, solids (2540B, C, and D-2015), turbidity (2130B-2011), total N (calculation), total Kjeldahl N (4500NORGD-2011) nitrate (EPA-300.0), nitrite (EPA-300.0), ammonia N (4500NH3D-2011), total P (EPA-200.7), and orthophosphate (4500PE-2011). Unmanned aerial vehicle (UAV) footage or images will be obtained to document project activities and demonstrate differences in water capture, storage, reuse, and infiltration.

Objective 2: *Improve rice productivity and profitability.*

At each demonstration location, we will determine crop health via UAV imagery and rice grain yield using a commercial combine equipped with on-board calibrated yield monitor (Atwill et al., 2020; Stone et al., 1996). Net returns above expenses will be calculated as described in our previous work (Spencer et al., 2019). Briefly, the approach will be to use partial budgeting analysis to compare net returns of furrow-irrigated rice without tailwater recirculation to furrow-irrigated rice with tailwater recirculation. For each field, we will determine costs and returns to calculate net returns. Costs will include irrigation costs and other associated costs. Irrigation costs are based on water usage and field-specific irrigation delivery systems and include labor, diesel fuel or electricity, irrigation supplies, repair and maintenance, and interest. We will calculate other associated costs of implementing a furrow-irrigation system with tailwater reuse by identifying the costs of tailwater recirculation that vary from a furrow-irrigated system without tailwater reuse. The time and number of persons associated with the installation, calibration/validation, repair, and removal of the tailwater recirculation equipment will be tracked by the researchers at each field location. We will calculate the costs of irrigation equipment by amortizing the initial costs of installation over the system's lifespan to get a per-hectare, per-year cost. We expect the costs of the furrow-irrigated system with tailwater reuse to exceed costs for the furrow-irrigated system without tailwater reuse, but that additional costs will be outweighed by increased revenue.

Objective 3: *Increase knowledge and promote implementation of strategies that reduce nutrient loss in rice.*

We will facilitate adoption of nutrient reduction strategies in rice by employing traditional and innovative Extension programming and partnering with public and private groups that have existing networks of rice farmers. Through the previous survey work conducted by our team, farmers report that their most trusted sources of information are university Extension specialists (89%), crop consultants (65%), and other farmers (65%) (Gina Rico-Mendez, unpublished data). We will transfer information from Extension specialists to farmers via one-on-one interactions, electronic media, and presentations at established meetings such as the Mississippi State Row Crop Short Course (~150 farmers) and the National Conservation Systems Cotton and Rice Conference (~250 farmers). We will also educate crop consultants via one-on-one interactions. Finally, we will facilitate farmer-to-farmer interactions by leveraging existing farmer networks within Mississippi State's Row Crop Short Course and the National Conservation Systems Cotton and Rice Conference. We have successfully deployed this strategy in the past and have received very positive feedback from participating farmers. The number of contacts, method of delivery, and impact will be tracked and reported for each of these outreach techniques.

Mississippi State University Responsibilities:

- Complete oversight of all project activities and deliverables.
- Purchasing all water-level sensors.
- Purchasing all monitoring equipment.
- Purchasing all tailwater recirculation equipment.
- Procuring other experimental supplies and materials for the project, such as lay-flat polyethylene tubing, irrigation fittings, sampling equipment, and miscellaneous materials.
- Retaining ownership of all project equipment, supplies, data, reports, records, documentation, or other project materials.
- Contracting with third-party vendors for installation of pumps and power supply.
- Conducting UAV flights and imagery acquisition.
- Processing and analyzing UAV imagery.

- Contracting with an EPA-certified laboratory for water quality analyses.
- Conducting statistical analyses.
- Interpreting project results.
- Providing project oversight.
- Providing standardized protocols.
- Providing data collection procedures.
- Preparing all EPA reports.
- Maintaining communication with EPA program personnel.

Mississippi State University retains final authority regarding project implementation, protocol modifications, data use, reporting, equipment deployment, demonstration site approval, and interpretation of project requirements.

Subcontractor Responsibilities:

We are soliciting bids for assistance in all three objectives. For Objectives 1 and 2, the successful bidder will manage at least 12 paired water quality demonstration locations over the course of the project, with a minimum of three paired water quality demonstration locations per year. The successful bidder will be responsible for irrigation management per project specifications, water level sensor installation, installation and setup of irrigation infrastructure from pump to field crown, equipment maintenance, monitoring production progress, monitoring crop growth and development, and site decommissioning after irrigation season and prior to harvest. Furthermore, the successful bidder will assist Mississippi State University with data collection, including water use, yield, and yield components. The subcontractor will utilize an MSU-provided McCrometer FS100 flow straightener that has an attached McPropeller bolt-on saddle flowmeter (McCrometer, Inc., Hemet, California) at the field inlet to quantify water use. Rice grain yield will be determined using a commercial combine equipped with an on-board calibrated yield monitor, typically accomplished by the cooperating producer with assistance from the successful bidder and Mississippi State University to ensure data is recorded and retrieved. Additionally, the subcontractor will assist MSU in collecting mature rice plant samples from three 1-m^2 areas at the top, middle, and bottom of every field (9 total samples per field) for yield component and seed quality analyses. At the field, the subcontractor will assist with plant height measurements, panicle weights, 1-m^2 weights, and separating samples as directed by MSU. Plant heights will be obtained from 10 random plants contained within each 1-m^2 subsample. Panicle weights will be obtained from 15 random panicles within each subsample. From each 1-m^2 subsample, approximately 2 kg of fresh biomass will be obtained for subsequent analyses by MSU. The successful bidder will also assist in identifying suitable project locations and maintain contact as appropriate with the participating grower. For Objective 3, the successful bidder will disseminate information to regional growers, consultants, landowners, and other stakeholders on rice water management practices to reduce runoff and improve profitability. The successful bidder will help leverage the existing farmer-to-farmer networks to expand outreach.

<u>The subcontractor shall</u>:

- Identify and propose suitable cooperating producers and demonstration sites. Final site approval shall be made by Mississippi State University.
- Maintain communication with cooperating producers.
- Coordinate project implementation at each location.

- Maintain a minimum of three paired demonstration locations annually and twelve paired demonstration locations over the project period unless otherwise approved in writing by MSU.
- Install water-level sensors and telemetry equipment supplied by MSU.
    - Prior to initiation of irrigation activities, contractor shall submit an Equipment Installation Report documenting sensor installation dates, location identifiers, equipment serial numbers, and operational status.
- Maintain water-level monitoring equipment and replace promptly in the case of equipment malfunction or damage.
- Install MSU-provided lay-flat polyethylene tubing, irrigation fittings, and other materials necessary to transfer water from the recirculating pump to the cooperating grower's polypipe at the field crown.
- Monitor field conditions and irrigation activities at least once every 14 days.
    - Documentation of each site visit, including date, location, observations, irrigation status, equipment status, and any corrective actions taken, shall be maintained and provided to MSU upon request.
- Assist with irrigation management according to project protocols.
- Collect required agronomic, water use, and other measurements under the direction of MSU project personnel.
- Maintain complete project records.
- Completely decommission each location after irrigation has terminated and before harvest. This includes removal of all project equipment and materials, except for the tailwater recirculating pump and its power source. Project equipment and materials shall be transferred to an MSU-approved location for storage during the non-crop season.
- Notify MSU project personnel as soon as possible, but no later than after twelve (12) hours of discovery of equipment failures, site losses, significant irrigation interruptions, sensor malfunctions, or other events that may compromise project objectives, data quality, or project implementation.
- Conduct outreach activities.
- Submit progress reports to MSU by the prescribed due date.
    - Progress reports detailing:
        - Demonstration site status.
        - Irrigation activities.
        - Equipment maintenance activities.
        - Crop development observations.
        - Data collection completed.
        - Outreach activities completed.
        - Issues affecting project execution.
        - Planned activities for the following period.
        - Progress reporting periods and due dates:

Reporting and Deliverable Period	**Due Date to MSU**
January – March	April 15
April – June	July 15
July – September	October 15
October - December	January 15

- Submit deliverables as prescribed:
    - Equipment installation reports.
    - Progress reports.
    - Electronic copies of all datasets collected within 30 days of collection or upon request by MSU project personnel.
    - Electronic datasets shall be provided in Microsoft Excel (.xlsx) or comma-separated value (.csv) format unless otherwise specified by MSU.
    - Outreach summary including date, audience type, approximate attendance or number of contacts, delivery method, and topic discussed.
    - Other information reasonably requested by MSU in support of project requirements.
- The subcontractor may not publish, distribute, present, or otherwise release project information without the prior written approval from MSU.
- If a demonstration location becomes unavailable due to circumstances outside the subcontractor's control, the subcontractor shall make reasonable efforts to identify a replacement location and shall immediately notify MSU

Failure to satisfy the requirements, reporting obligations, deliverables, or performance standards described herein without prior written approval from MSU may constitute unsatisfactory performance and may result in corrective action or other remedies available under the subcontract agreement.